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ABSTRACT

The research reported in this paper is the result of a project to develop a preschool mathematics curriculum for economically deprived children in Hawaii. The developed materials were tested with preschool children in Head Start classes and a preliminary assessment of the curriculum was made. An attempt was made to evaluate the curriculum which was developed by comparing gains from pretest to posttest in several measures of mathematical knowledge and understanding for classes that had been trained for twenty minutes per day with the new curriculum versus classes which received no training. Tasks presented to the children in the experimental groups related to number and counting, geometry, dimension, prearithmetic operations, and symbols. The Geometric Design, Arithmetic, and Block Design subtests of the WPPSI; an experimental form of the Head Start Arithmetic Test; and two Piagetian conservation tasks were administered to the children in three experimental classes and two comparison classes. Using an analysis of covariance, results on the Geometric Design ($p=.001$) and Block Design ($p=.05$) subtests were found to be significantly in favor of the experimental group when the total experimental group was compared to the total comparison group. The amount of change between pre- and posttesting with the Head Start Arithmetic Test was found to be significantly greater ($p=.02$) for the experimental than for the comparison group. (FL)

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PRESCHOOL MATHEMATICS CURRICULUM PROJECT

Education Research and Development Center
University of Hawaii

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University of Hawaii
Head Start Evaluation and Research Center
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Final Report on Preschool Mathematics Curriculum Project

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November, 1969

Abstract

Objectives

The present project provided for the development of a detailed quantitative curriculum appropriate for use in Head Start classes, trial of the developed materials with preschool children in Hawaii, and preliminary assessment of the curriculum in comparison with a more spontaneous, informal quantitative classroom experience.

Procedures

Directions for tasks related to number and counting, geometry, dimension, prearithmetic operations, and symbols were prepared and revised throughout the school year 1968-69 and presented to 55 children in three experimental classes daily in 20-minute lessons. The tasks were then compiled into a teacher's manual. The Geometric Design, Arithmetic, and Block Design subtests of the WPPSI; an experimental form of the Head Start Arithmetic Test[1]; and two Piagetian conservation tasks were administered to the experimental subjects and 30 subjects in two comparison classes to measure mathematical knowledge and understanding.

Results

The mean scores on the WPPSI subtests for the experimental classes were all above the standardized norms and consistently higher than for

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[1]Louise Wohl, "The Development of an Instrument to Measure the Arithmetic Achievement of Head Start Children in Hawaii" (Master's thesis, University of Hawaii, 1968). See Appendix C.

the comparison classes. The differences were statistically significant on the Geometric Design and Block Design subtests. The net gain on the Head Start Arithmetic Test was also significantly greater for the experimental group than for the comparison group.

PREFACE

This study was conducted with the cooperation of the following classroom teachers and aides:

Ellen Anderton--University of Hawaii Preschool--classroom teacher in experimental class

Hilda Cobb--Waimanalo Elementary School--experimental teacher

Fumiko Inouye--Harris Memorial Methodist Church Preschool--teacher of comparison class

Joan Mendenhall--University of Hawaii Preschool--classroom teacher in experimental class

Linda Moore--Harris Memorial Methodist Church Preschool--teacher of comparison class

Cecilia Bierne--University of Hawaii Preschool--aide

Darleen Cueva--Harris Memorial Methodist Church Preschool--aide

Mrs. Nuuhiva--Waimanalo Elementary School--aide (temporary)

Kim Tasaka--Waimanalo Elementary School--aide

Mary Velascos--Harris Memorial Methodist Church Preschool--aide

Sylvia Yamada--University of Hawaii Preschool--aide

The following members of the Head Start Evaluation and Research Center staff, in addition to the co-investigators, contributed to the project by teaching or by assisting in the development of the curriculum, collection and analysis of data, or preparation of the final report:

Christina Anderson

Betty Crooker

Gloria T. Daley

Susan Fukumoto

Betty Parker

One of the cognitive areas in which an early deficit may produce increasingly deleterious effects upon school achievement is that often referred to as quantitative ability. Indeed, admission to universities and graduate schools typically is dependent in part upon a measure of this kind of ability. For this reason, early attention to children's learning to reason in numerical terms and understand quantitative concepts, and, in general, to preparation for dealing with the symbolic language of mathematics is essential.

Exploratory efforts to foster development of quantitative abilities at the preschool level seemed especially desirable. Because a ready-made curriculum adaptable to these ends at the preschool level did not seem to be available, the University of Hawaii Head Start Evaluation and Research Center prepared a syllabus that was used in three Head Start classes. On the basis of this year of teaching experience, the curriculum was revised, expanded, and compiled as a teaching manual to be used in classrooms where further evaluation could be done.

Objectives

The principal objective of this project, then, was to develop a preschool mathematics or quantitative curriculum for economically deprived preschool children that would: (a) include a mathematical language appropriate for disadvantaged four-year-olds to enable them to verbalize quantitative and spatial observations; (b) provide experiences for children in manipulating materials or objects that illustrate quantitative relations; (c) allow for specific instruction in small groups (of five to seven or eight children) as well as for further informal instruction in less structured classroom situations; (d) yield a

manual that preschool teachers could use to provide a detailed sequence of content, including exercises and review, related to the learning of mathematical or quantitative thinking.

Since the curriculum in question was being developed and revised during the year, its tentative evaluation could be regarded as only a secondary objective. Nevertheless, the aims of the project included preliminary attempts to evaluate the general approach by comparing gains, from pre-test to post-test, on several putative measures of the objectives for small numbers of classes that had been trained for 20 minutes per day with the curriculum versus classes not so trained.

Procedures

Although the principal objective of this study was development of a quantitative curriculum that, upon its completion at the end of a year, could be tried experimentally with a sizable number of preschool (in this case, Head Start) classes, tryout during the year of the initial study was regarded as essential to a "self-correcting" process of curricular development. As a result of explorations of possibilities before the project was under way, the expectations had been that the curriculum in the process of being developed could be used in four classes that could be compared with respect to gains in various relevant measures to other classes not exposed to the curriculum. Difficulties in locating both "experimental" classes--that is, those in which the new treatment would be tried in the process of its development--and appropriate comparison classes, coupled with logistic problems in assigning sufficient testing staff to the proper places at desired times for pre-testing, necessitated the reduction in the number of experimental classes to three and comparison classes to two.

One Center staff member (Karen Kelly) designed 30 tasks, with appropriate directions and suggested 'props' to fulfill the goals of the study. These were used by her in presenting lessons to two classes (University of Hawaii Preschool) and by the regular classroom teacher of another preschool class (Waimanalo Elementary School). These constituted the experimental classes. Two other Head Start classes at the Harris Memorial Church Preschool were used as the comparison groups. Work on the manual of lessons for the experimental classes expanded as the year progressed. The teachers presented 20-minute lessons daily to small groups of children (five to seven in number). At first each lesson included two or three tasks selected from a preschool language curriculum previously developed by the Center, concentrating on words and patterns considered prerequisite to children's use of quantitative labels and descriptions. These were increasingly supplemented by more specifically quantitative tasks. In one experimental class (class 1 in the later analysis) beginning around February, 1969, the Center staff member used lessons consisting only of specifically quantitative tasks, as the regular teacher began presenting language lessons based upon the Center's Preschool Language Curriculum. Illustrations of the types of quantitative lesson plans used are presented in Appendix A.

In the experimental class at Waimanalo, a rotation system was used for structuring the classroom activity during the time that quantitative lessons were conducted. Under the rotation plan, three kinds of activity take place: the formal quantitative lesson, activities designed to strengthen the particular quantitative skills taught in the lessons, and activities centering around supplemental school skills somewhat

less directly related to quantitative ability. Classes are divided into three groups that rotate among these three types of activity in a pre-established way, participating in each for 20 minutes.

Until the end of January, 1969, in the two classes at the University Preschool, small groups of children were assembled from their regular classroom activities to participate in quantitative lessons; i.e., the rotation system was not used. One of these teachers chose throughout to operate without the rotation system, which she perceived as being incompatible with the individualized auto-tutorial curriculum in her classroom. The other originally rejected the rotation system but elected to use it beginning at the end of January. Because of the exploratory nature of the study, such departures from rigorous adherence to uniformity were not regarded to be of significant consequence.

In addition to the original quantitative tasks, other curricular units were developed during the school year. The sequence was not prescribed; each teacher of an experimental class selected tasks on the basis of variety and the level of difficulty judged by her to be appropriate for her group or groups. Both teachers wrote lesson plans and evaluations daily, and they taped lessons occasionally to record the actual events during lessons. The University experimental teacher observed the Waimanalo class three times during the year. (Because she was ordinarily occupied in teaching, more observations were not possible.) Other contacts were by phone, written notes, and tapes. The two teachers conferred about the weaknesses, strengths, needs, and progress of the children. Revisions and additions were made accordingly.

The tasks included a variety of mathematical topics in elementary form: counting, number, numerals, prearithmetic operations, geometry,

conservation, and measurement. Appropriate commercial materials were used to implement most tasks. When such materials were not available, original aids were constructed. Demonstrations and explanations were provided by the teachers, but the emphasis was on verbalization and manipulation by the children. They were taught to verbalize the names of geometric figures, instruments of measure, and numerals; to count; and to compare dimensions. Children practiced measuring, constructing geometric figures, writing numerals, arranging objects by order or number, and combining and separating sets. The small-group setting allowed for a high degree of active participation by the children and ongoing reaction by the teacher.

Although quantitative lessons ideally would have been presented daily, certain events prevented this. Excursions, teacher illness, and business trips supplanted the lessons more often in the University classes than in the Waimanalo class. The actual number of days of intervention in the Waimanalo class was 152; in one of the University classes, 129; and in the other, 121..

An inventory of materials relevant to quantitative concepts was made in each of the experimental classes and in the two comparison classes. The lists (Appendix B) indicate that there were more classroom materials that could account for incidental learning in the comparison classes than in the experimental classes. In addition, comparison class teachers were interviewed and classes were observed to determine the nature and extent of mathematical activities offered. Children in their classes were encouraged to discuss number in pictures; utilize one-to-one correspondence in natural situations; share, count, and match; measure plants to see whether they had grown; use numbers and counting in connection with music; and recognize size and shape. These two teachers

evidently took advantage of natural situations, as well as setting up game situations to teach quantitative concepts.

An experimental manual, entitled University of Hawaii Preschool Quantitative Curriculum, was written in the summer of 1969. It is divided into five sections: Counting and Numbers, Geometry, Dimensions, Operations, and Symbols. Each section is reproduced in a different color and is divided into detailed activities that are consecutively numbered. Activities from different sections are intended to be taught concurrently, but activities within sections are roughly sequenced in the order in which they are intended to be presented. The manual will be revised and expanded during the 1969-70 school year.

Instrumentation

The children attending the experimental and comparison classes were pre-tested early and post-tested late in the school year. The following battery was used to assess mathematical knowledge and understanding: the Geometric Design, Arithmetic, and Block Design subtests of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI); an experimental form of a new test called the Head Start Arithmetic Test (see Footnote 1 and Appendix C); and two Piagetian conservation experiments.[2]

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[2]Millie Almy, Young Children's Thinking (New York: Teacher's College Press, 1966), pp. 52-53. Tom Trabasso, "Pay Attention." Psychology Today (October, 1968), p. 34.

The WPPSI subtests that were chosen appeared to be related to the objectives of the curriculum and represented tasks that had been standardized for large numbers of children at age levels appropriate for comparison to groups of Head Start children. The Block Design and Geometric Design subtests included tasks related to spatial concepts presented in the curriculum that were not included in the Head Start Arithmetic Test. The Arithmetic subtest provided another measure of related tasks, although the items used involved only counting and indeterminate numbers; hence, it did not reflect the entire content of the curriculum as well as the other criterion measures used.

The Head Start Arithmetic Test was designed to measure young children's arithmetical development in four areas. There are items that require counting and number concepts, recognition and writing of numerals, simple computation, and language related to general numerical information such as time and money concepts, measurement, and indeterminate number. Although still in an experimental form, this test was included because of its close relation to the objectives of the curriculum.

The conservation experiments were designed to measure comprehension of invariation of number, mass, volume, and length. Conservation tasks were administered to two of the experimental classes at the end of the year only, after the WPPSI subtests and the Head Start Arithmetic Test had been completed. Half of the children in these classes had first the tasks described by Trabasso and half hadfirst the Almy tasks.

Results and Discussion

Children attending the three experimental and two comparison classes were pre-tested and post-tested. Of the 87 children in the study at the

beginning of the year, several were not available for testing in the spring because of withdrawal from school or repeated illness. Test results of several children who were untestable during the fall of 1968 also could not be included in the statistical analyses, although they became testable during the year. For them it can only be stated that qualitative improvement was indicated.

Pre-test means for each class indicated a high level of comparability among individual classes tested. An analysis of covariance was applied to the scaled scores from the post-test administration of the WPPSI subtests for five classes considered separately, using pre-test scores as the covariate. The experimental classes scored above the comparison classes in all but one case, although individual comparisons were not significant with the small numbers of subjects found when only single classes were used. These data are presented in Table 1. On all of these subtests, the mean scores of the experimental classes fall above the average scaled score of 10, indicating that these groups of children scored higher than the WPPSI standardization sample.

The same analysis was done using the total experimental group versus the total comparison group. These data indicate highly significant ($p = .001$) results in favor of the experimental group on the Geometric Design subtest and significance at the .05 level in favor of the experimental group on the Block Design subtest. See Table 2.

The same analysis was then applied to each experimental class versus the entire comparison group (two classes) in order to see individual variations among the experimental classes. In all but one of nine comparisons, the experimental classes scored higher than the comparison group. Since the comparison classes were better equipped in terms of

materials relevant to quantitative learning and both comparison teachers did provide situations for quantitative experiences, the results suggest that the regularity and specificity of the curriculum improves the performance of preschool children, especially on the measure of Geometric Design. One of the classes also made significant improvement on the Block Design and another showed improvement, although not significant, in this area. See Table 3.

The Head Start Arithmetic Test is still in an experimental form; hence, extensive norms are not available. Raw scores for both experimental and comparison groups are presented in Table 4. A correlated t test to assess the relative amount of change between pre- and post-testing was applied, using the formula:

$$t = \frac{D_E - D_C}{\sqrt{S^2_{D_E} + S^2_{D_C}}},$$

where D_E and D_C refer to the differences in means for the experimental and comparison groups, respectively, and $S^2_{D_E}$ and $S^2_{D_C}$ are the squares of the standard errors of the differences in means for the experimental and control groups, respectively.

The difference in the net change between the two groups was significant at better than the .02 level. The items included in this instrument rather closely reflect many of the content areas and objectives of the quantitative curriculum.

TABLE 1

Adjusted Post-Test Means and F Ratios for Arithmetic, Geometric Design, and Block Design Subtests from the WPPSI for Three Experimental (1, 2, 3) and Two Comparison (4, 5) Classes (Scaled Scores)

Classes	Arithmetic	Geometric Design	Block Design
1	10.27	11.46	11.40
2	10.62	11.99	12.16
3	10.05	12.65	10.23
4	9.96	10.39	10.36
5	9.91	9.69	9.58
F	.32	3.69***	1.76*
df	4,69	4,69	4,69

*p = .10
***p = .01

TABLE 2

Adjusted Post-Test Means and F Ratios for Arithmetic, Geometric Design, and Block Design Subtests from the WPPSI for Experimental and Comparison Groups (Scaled Scores)

	Arithmetic	Geometric Design	Block Design
Experimental	10.32	12.02	11.30
Comparison	9.94	10.08	10.01
F	0.61	12.13****	3.18**
df	72,1	72,1	72,1

**p = .05
****p = .001

TABLE 3

Adjusted Post-Test Means and F Ratios for Arithmetic, Geometric Design, and Block Design Subtests from the WPPSI for Each Experimental Class and Comparison Group (Scaled Scores)

	Arithmetic	Geometric Design	Block Design
		Experimental Class 1	
Experimental(1)	9.94	11.25	11.50
Comparison	9.59	9.89	10.08
F	0.29	3.07*	2.39
df	40,1	40,1	40,1
		Experimental Class 2	
Experimental(2)	10.57	12.17	12.11
Comparison	10.01	10.15	10.01
F	0.66	7.45	5.77**
df	41,1	41,1	41,1
		Experimental Class 3	
Experimental(3)	9.82	12.53	10.21
Comparison	9.95	9.97	9.99
F	0.03	11.36****	0.04
df	39,1	39,1	39,1

*p = .10
**p = .05
***p = .01
****p = .001

TABLE 4

Pre-Test and Post-Test Means and Correlated *t* Test for Head Start Arithmetic Test for Experimental and Comparison Groups (Raw Scores)

	Pre	Post
Experimental	32.77	60.42
Comparison	29.50	43.57

t = 2.49
p = .02

The conservation measures were tried out for only two of the experimental classes at the post-test stage, primarily to obtain information as to whether they would be serviceable as criterion measures in later work with the curriculum. It was not feasible to obtain these measures for the third experimental class or for the two comparison classes. Although for the Almy conservation tasks some comparisons could be made between the results for the Hawaiian preschool children and children in her New York kindergarten sample, these results will not be presented in any detail because the two groups could not be regarded as comparable. The New York group was older by eight months on the average; they had been selected as having adequate language ability; and they had received no specific training in conservation.

On the three Almy tasks (A, B, and C), the test results for the Hawaiian children appear to be directly related to the amount of instruction provided. None of the children succeeded in Task A (conservation of number in relation to length without the aid of counting), to which no tasks in the Preschool Quantitative Curriculum were related. Eight activities in the curriculum were concerned with conservation of volume (Task C), and 20% of the children succeeded in Task C. In Task B (conservation of number with the aid of counting), to which more than eight curriculum activities were related, 40% of the children succeeded.

Compared with the New York kindergartners, substantially more Hawaiian children succeeded on at least one conservation task.

On the Trabasso tasks, which involve volume, number, mass, and length, 20% of the Hawaiian children showed conservation skills, and all of these successful children were above the mean ages for their respective classes.

It is yet too early for any claim that the sequence of the lessons incorporated in the manual is the best possible. Further experience with the materials during the current school year will likely dictate shifts in the sequencing as well as revisions, deletions, and additions.

APPENDIX A

Illustrations of Topics and Tasks

Used in the Quantitative Curriculum

The Quantitative curriculum is composed of a number of specific tasks designed to be taught to small groups of preschool children. Exemplary tasks are listed below to illustrate briefly how mathematical concepts are presented to the children. The list is incomplete; the tasks that are included in the curriculum manual are numerous and more detailed. Any given task is presented on numerous occasions, sometimes using different materials and in expanded form as the children progress. Following the list of tasks is a sample lesson plan to show how tasks are put together in one twenty-minute lesson.

TOPIC	BEGINNING TASK	INTERMEDIATE TASK	ADVANCED TASK
Counting & Number	1. Chant counting sequence, e.g., 4-5, 4-5, then expand downwards and upwards. 2. Teacher counts chips into child's hand, then child counts chips into teacher's hand, e.g., 1-2-3. 3. Match numbers, e.g., teacher puts 3 pegs into pegboard holes, child matches.	1. Child counts objects, teacher asks how many objects the child counted. 2. Recognize number without counting. 3. Count first row of beads on a counting frame, count second row, then estimate number of beads in third row.	1. Child gives other child 5 coins or draws 6 circles or put 7 toys in the box. 2. Count past 20.
Geometry	1. Discriminate circle, square, triangle and identify. 2. Draw lines without rulers, with rulers, between points.	1. Draw geometric figures with fewer and fewer cues. 2. Discriminate and identify rectangle, sphere, cone.	1. Teacher asks child what he can tell her about a figure, e.g., a square, and expects child to supply properties of that figure. 2. Discriminate and identify figures as flat or solid.

TOPIC	BEGINNING TASK	INTERMEDIATE TASK	ADVANCED TASK
Comparison of Number and Dimension (incl. measurement)	1. With about two items that are different in one dimension, child makes observations such as, "This line is long; this line is short."	1. Child compares items that are different in one dimension, using statements such as, "Kathy is older than James."	1. Child figures out how much different two different items are.
	2. Child measures by counting units.	2. Child produces matching lengths, volumes, etc.; e.g., "pour the same amount of water in this cup that you see in this cup; draw a triangle that is the same size as this triangle."	2. Child actually measures objects, using rulers, scales, etc.
	3. Child identifies common instruments of measurement and relates them with appropriate dimensions.	3. Child justifies comparative observations, e.g., "This square is bigger that this triangle because the square is 4 units and the triangle is 3 units and 4 is more than 3.	3. Child participates in conservation experiments, verbalizing observations.
	4. Child sorts sets of one and more than one, two and more than two, etc.		4. Child estimates measurements and justifies estimates.
Pre-Arithmetic Operations	1. Count elements of two sets independently, then altogether.	1. Answer questions "How many fingers do you have on your right hand"? "How many fingers do you have on your left hand"? "How many fingers do you have altogether"?	1. Answer questions such as, "How many bears are in the picture"? "How many camels are in the picture"? "Now without counting, how many animals are in the picture altogether"?

TOPIC	BEGINNING TASK	INTERMEDIATE TASK	ADVANCED TASK
	2. Play store. Child counts pennies needed to buy given item, matching his pennies with a picture price tag.	2. Play store. Child figures out what he is able to buy with the amount of money he has, how much more he would need to buy certain items, and how much he would have left if he bought certain items.	2. Child figures out how much various items cost by identifying the numerals associated with them, then figures out how much two or more items cost from experience.
Numerals--Writing and Recognition	1. Trace numerals. 2. Copy parts of numerals. 3. Flashcard drills 1-3.	1. Flashcard drills. 2. Copy numerals 1-6.	1. Copy numerals 1-10. 2. Flashcard drills 1-10.

SAMPLE LESSON PLAN: (20 minutes)

1. Number sequence

Ask children: "What comes after ..."? questions.
Start with ...after 15? ...after 16? ...after 19? ...after 20? ...after 29?
If the task is too difficult, review the same task with smaller numbers out of sequence, then in sequence if necessary.

2. Measurement

Review what children know about a ruler and its use. Ask children to estimate the length of a peg and the length of a crayon. Children then verify by actually measuring.

3. Flashcard and object drill

Include numerals, plane figures, solid figures, scale, thermometer, ruler. Require only one-word answers.

4. Constructions

Pass out clipboards. Ask children:
1) "Draw a square and tell me what you can about it."
2) "Draw a triangle and tell me what you can about it."

Ask children if they can draw a closed figure that has only two sides ...five sides.

APPENDIX B

Materials Available in Classrooms

That Are Relevant to Quantitative Instruction

	Instructional Materials	Experimental Classes (Mendenhall) #_____	(Anderton) #_____	(Cobb) #_____	Comparison Classes Materials Shared
1.	Number Charts				X
2.	Poster--illustrating "more than one"				X
3.	Books about number	X	X	X	X
4.	Flashcards				X
5.	Posters by Owens, 'Number Concepts"				X
6.	Pictures that illustrate number	X	X	X	X
7.	Numeral Cards, Perception Cards	X	X		X
8.	Sandpaper numerals				X
9.	Calendar	X	X	X	X
10.	Flannel cutouts of geometric shapes		X	X	
11.	Numeral writing books	X			
12.	Clock	X	X	X	X
13.	Unit blocks	X	X	X	X
14.	Parquetry Blocks	X	X	X	X
15.	Color Cubes	X	X	X	
16.	Design blocks				X
17.	Beads	X	X	X	X
18.	Pegs and pegboards	X		X	X
19.	Interlocking numeral puzzle with pegs	X			X
20.	Interlocking numeral puzzle with matching pictures		X		X
21.	Form Board	X	X	X	
22.	Geometric Inserts	X	X		
23.	Thermometer	X		X	
24.	Steins graduated rods		X		
25.	Cuisenaire rods		X		
26.	Counting frame, large				X
27.	Counting frame, table size		X		X
28.	Cash Register		X	X	
29.	Graduated cups		X		
30.	Graduated cylinders	X			
31.	Domino form board 1-5	X		X	
32.	Abacus				X
33.	Rulers			X	X
34.	Geometric solids, large			X	X
35.	Geometric solids, small				X

Instructional Materials	Experimental Classes (Mendenhall) #_____	(Anderton) #_____	(Cobb) #_____	Comparison Classes, Materials Shared
36. Play tiles		X		X
37. Clock Puzzle				X
38. Bowling pins, keeping score				X
39. Ring toss, keeping score				X
40. Measuring cups			X	X
41. Dominoes			X	
42. Blocks with different numbers of holes			X	
43. Color cone			X	
	17	19	20	28

APPENDIX C

Instructions and Answer Sheet

for the Head Start Arithmetic Test

Administration Instructions -- Head Start Arithmetic Test*

All questions in parentheses on the answer sheet are presented verbally, without any visual stimulus. These have been put in parentheses to assure they are not omitted while the visual items are being presented. All items should be administered except those designated as eliminated because of failure on easier items. Much encouragement and praise should be given throughout the exam. Verbal instructions to children are written in capital letters.

1. SHOW ME HOW HIGH YOU CAN COUNT.

   If the child is hesitant, start counting, ONE - TWO - THREE - and as you count, tap with your hand on the table. Be certain the child has counted as high as he can by continuing to tap even after he stops. He may begin over if necessary.

   Credit: If counts to 10 correctly.

2. Credit: If counts above 10 correctly.

3. YOU SAY WHAT I SAY. I SAY 1 2 3 4 5.

   Items 3 and 4 are not presented if child passes item 1, but give credit.

4. YOU SAY WHAT I SAY. I SAY 1 2 3 4 5 6 7 8 9 10.

   Make certain the child is paying close attention. Have him facing you. Count at 2 numbers per second.

   Credit: If child repeats the series correctly.

5. COUNT JUST TO 3 AND STOP. NOW REMEMBER, COUNT JUST TO THREE AND STOP.

   Credit: If child counts correctly to number indicated and stops. (No demonstration permitted.)

6. Repeat except substitute "5".

7. Repeat except substitute "10".

8. HERE ARE BOXES. (Point to each box separately.) EACH BOX HAS SOME BALLS IN IT. (Point to ball not boxed.) NOW FIND THE BOX THAT HAS ONE BALL IN IT.

   If child points to ball outside the box you pointed to, say:

   NO, YOU FIND THE BOX (point to each box) THAT HAS ONE BALL IN IT.

   If child points to an incorrect box the item is marked wrong but it is repeated with the examiner pointing to the answer. Do not proceed to the next item until the child has pointed to the correct answer. With some children, it becomes necessary to cover the sample ball(s).

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* Experimental Edition, unpublished M.A. thesis by Louise Wohl, Department of Educational Psychology, University of Hawaii

9. Repeat as in item 8, except substituting "2" for number of balls. Do not use as a demonstration item.

10. Repeat as in item 8, except substituting "3" for number of balls.

11. Repeat as in item 8, except substituting "4" for number of balls.

12. HOW MANY CARS ARE HERE? (Point to the object(s).)

    Credit: If child says correct number or shows correct number of fingers.

13. HOW MANY TURTLES ARE HERE?

14. HOW MANY FISH ARE HERE?

15. HERE ARE 2 TOYS. POINT TO THE BOX WITH 2 TOYS IN IT.

    Follow procedure of item 8 if necessary. May use this item as demonstration

16. HERE ARE 3 TOYS. POINT TO THE BOX WITH 3 TOYS IN IT.

Omit remaining items through item 23 after child fails 2 consecutive items.

17. HOW MANY STARS ARE HERE? COUNT HOW MANY STARS ARE ON THIS PAGE.

18. HOW MANY BIRDIES ARE HERE? COUNT HOW MANY BIRDIES ARE ON THIS PAGE.

19. HOW MANY PENCILS ARE HERE? COUNT THEM.

20. HOW MANY STARS ARE HERE? COUNT THEM.

21. HOW MANY STARS ARE HERE? COUNT THEM.

22. HOW MANY JARS ARE HERE? COUNT THEM.

23. HOW MANY BOATS ARE HERE? COUNT THEM.

24 through 29: WHAT NUMBER IS THIS? (Point to number when saying it.)

Omit remaining items through item 29 if fails on 2 consecutive items.

30. SEE THIS NUMBER? TELL ME WHAT IT IS.

    (If child can't verbalize the correct response, omit the item.)

FIND THIS NUMBER (point) OF FLOWERS.

Cover test item on same page not being tested. Do not eliminate the next item if fails this one. Often child can identify the number "one" and not the number "two".

31. SEE THIS NUMBER? (Point.) TELL ME WHAT IT IS. FIND THIS NUMBER (point) OF BIRDIES. (If child can't verbalize "one", omit this item and next two items.) Continue to cover unused portion. Omit 32 and 33 if fails 30 and 31.

32. SEE THIS NUMBER? (Point.) FIND THIS NUMBER (point) OF FISH.

33. SEE THIS NUMBER? (Point.) FIND THIS NUMBER (point) OF BALLS.

34-36. TELL ME WHAT THIS SAYS. (Point.)

Credit: If child reads the signs indicated on the answer sheet. Child may read entire problem, but gets credit only for indicated items. If child is unable to respond, point directly to the plus sign, and repeat question. If fails, omit items through 36.

37. WHICH GLASS HAS MORE SODA IN IT?

38. WHICH GLASS HAS LESS SODA IN IT?

39. HERE ARE SOME BALLS. FIND THE BOX THAT HAS BALLS LIKE THESE IN IT.

Point to the objects as they are mentioned.

40. HOW MANY GROUPS OF BANANAS ARE HERE? HOW MANY SETS OF BANANAS ARE HERE?

Point to each set. Use both sentences so that both "group" and "set" are used.

41. HOW MANY PENCILS ARE IN EACH SET? HOW MANY PENCILS ARE IN EACH GROUP?

Point to just one of the groups.

(42) WHEN YOU'RE COUNTING, WHAT NUMBER COMES AFTER "2"?

(43) WHEN YOU'RE COUNTING, WHAT NUMBER COMES AFTER "4"?

(44) WHEN YOU'RE COUNTING, WHAT NUMBER COMES AFTER "8"?

45. HOW MANY BLACK BALLS ARE HERE? (Do not point.)

46. HOW MANY WHITE BALLS ARE HERE? (Do not point.)

47. HOW MANY BALLS ARE HERE ALTOGETHER?

48. HOW MANY TOYS ARE HERE ON THIS PAGE? (Do not point.)

49. I HAVE A CAT. MY FRIEND GIVES ME ONE MORE. HOW MANY CATS DO I HAVE?

50. I HAVE TWO SHIRTS. MY AUNTIE GIVES ME THREE SHIRTS. HOW MANY SHIRTS DO I HAVE NOW?

(Cover top problem.)

51. I HAD 4 MARBLES IN A JAR. JOHNNY TOOK 2 MARBLES AWAY. HOW MANY MARBLES DO I HAVE LEFT IN THE JAR?

    Do not point. Cover bottom problem.

52. I HAD 7 FLOWERS GROWING. SUSAN CUT DOWN 3 OF THEM. HOW MANY FLOWERS DO I HAVE GROWING NOW?

53 and 54. Omit these problems (53 and 54) if failed 2 items in items 34-36.

Point to the problem. Cover the remaining problems. Do not read the problem to the child.

TELL ME WHAT THIS SAYS. If child reads it correctly, give praise and then request the answer.

Credit: If gives correct answer.

Items 55-59 are presented verbally. Close test book and make certain child is paying attention. Omit remaining items when fails two items.

(55) LISTEN. I HAVE 2 KITTENS. I FIND 1 MORE. HOW MANY KITTENS DO I HAVE NOW?

(Repeat these.)

(56) LISTEN. I HAVE 4 DOGS. ONE DOG GETS LOST. HOW MANY DOGS DO I HAVE NOW?

(57) I HAVE 3 TRUCKS. JOHNNY GIVES ME 2 MORE. HOW MANY TRUCKS DO I HAVE NOW?

(58) I HAVE 3 AND JOHNNY GIVES ME 3. HOW MANY DO I HAVE?

(59) I HAVE 6 AND GIVE 2 TO JOHNNY. HOW MANY DO I HAVE?

(60) WHEN WE WANT TO TELL TIME, WHAT DO WE LOOK AT?

Credit: clock; watch.

(61) TELL ME THE NAME OF ANY DAY.

Credit: name of any day.

(62) WHEN IS YOUR BIRTHDAY?

Credit: name of any month.

63. Open test book and say: POINT TO MANY BALLS.

64. WHAT IS THIS A PICTURE OF?

(Dollar.) If child says paper, ask what kind of paper.

65. WHAT IS THIS?

(Penny.) If child says money, ask what kind of money.

66. WHAT IS THIS?

(Nickel.)

(67) HOW MUCH DO YOU WEIGH?

If child names a quantity, ask what it is. Example: Child says "seven". Examiner says, GOOD, SEVEN WHAT?

Credit: word "pounds".

(68) WHO IS HEAVIER - YOU OR ME? (Point as saying question.)

Credit: May just point to examiner.

69. WHICH BLOCK IS LONGER?

70. WHICH BLOCK IS SHORTER?

71. POINT TO THE DUCK IN THE MIDDLE.

72. POINT TO THE FIRST DUCK.

73. POINT TO THE LAST DUCK.

74. POINT TO THE BALL THAT IS ONE-HALF BLACK.

(75) HOW MANY FINGERS DO YOU HAVE ON ONE HAND? COUNT THEM.

(76) HOW MANY LEGS DO YOU HAVE?

(77) HOW MANY EYES DOES A MAN HAVE?

(78) HOW MANY LEGS DOES A DOG HAVE?

- - - - - - - - - - - - - - - - -

This is the end of the book. Now give child written exercises.

Three ball page is a demonstration. PUT A MARK ON JUST ONE BALL. Examiner do it and child do it correctly. One line is best mark. NO X's.

79. PUT A MARK ON JUST 3 STARS.

80. PUT A MARK ON JUST 5 PENCILS.

81. PUT A MARK ON JUST 8 PENCILS.

82. PUT A MARK ON JUST 9 STARS.

83. WRITE "1" HERE. (Space A.) Point. 84. WRITE "2" HERE. (Space B.) 85. WRITE "4" HERE. (Space C.) Omit 85 and 86 if fails 83 and 84. 86. WRITE "10" HERE. (Space D.)
87. MAKE ONE LIKE THIS ONE (Copying 0). Point so that child understands. Encourage any attempt. Omit remaining items if fails 2 consecutive items. 88. (Copying 7). Directions same as for 87. 89 and 90. (Copying 14). Directions same as for 87. 91 and 92. (Copying 23). Directions same as for 87. Credit: 2 points if copies both numerals.

HEAD START ARITHMETIC TEST

Name_____ Date_____ Score_____

Center_____ Birthdate_____ _____

Examiner_____ C.A. _____ _____

(1)

(2)

(3)

(4)

(5)

(6)

(7)

8.

9.

10.

11.

12.

13.

14.

15.

16.

Omit if fails 2 consecutive

17.

18.

19.

20.

21.

22.

23.

Omit if fails 2 consecutive

24.

25.

26.

27.

28.

29.

Omit if fails 2 consecutive

30.

31.

32.

33.

Omit if fails 1

34. + ____

35. = ____

36. - ____

37.

38.

39.

40.

41.

(42)

(43)

(44)

45.

46.

47.

48.

49.

50.

51.

52.

Omit if fails 34 & 35

53.

54.

Omit if fails 2 consecutive

(55)

(56)

(57)

(58)

(59)

(60)

(61)

(62)

63.

64.

65.

66.

(67) lbs. ____

(68)

69.

70.

71.

72.

73.

74.

(75)

(76)

(77)

(78)

BOOKLET

Omit if fails 2

79.

80.

81.

82.

Omit if fails 2

83.

84.

85.

86.

Omit if fails 2

87.

88.

89.

90.

91.

92.